THE OPERATIVE TREATMENT OF IRREDUCIBLE SUBCUTANEOUS FRACTURES.

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The benefits accruing from modern methods of conducting an operation are so constantly in evidence that their discussion at this time seems trite. Yet it is only by keeping them in view that tentative suggestions in new fields can eventuate in things accomplished. Therefore only would I allude to the safety to life and limb with which compound fractures are now treated. A death following a compound fracture from wound infection is now a *rara avis*, even in hospital wards that are far from surgically clean. Barring the paramount danger of infection and its sequel, necrosis, there are factors which would render the prognosis as to restitution to the normal in compound fractures quite as good, if not better, than in those uncomplicated by a broken skin. The directness by which fragments can be moulded into position and retained by sutures, if need be, the ease with which intervening muscle or membrane can be removed, and the certainty with which an hæmatoma can be avoided at the site of injury, are data which, were it not for the danger of infection, would make the greater almost to be preferred to the lesser injury. So has the treatment of compound fractures been bettered by the grace of modern methods. In the absence of a like positive influence in the treatment of simple fractures, the results here obtained, on the whole, are much as they were during the three decades intervening between the introduction of anæsthesia and antiseptic surgery. Except in fractures of the simplest varieties, we share with our predecessors the anxieties from incomplete reduction, deformity, shortening, and of partial or complete ankylosis in articular and pararticular fractures. In regard to these as a class, indeed, only two steps in advance have been taken, and one of these is in the nature of a don't. There is an unanimity of opinion that by prolonged immobilization joint-function is jeopardized. To effect the best functional use of a joint "there must be a proper balance between rest and motion; rest of the broken bone, motion of the joint muscles, tendons, fascia. But even the methods to these ends are the subject of much controversy." This is one step. The other, a very decided advance, has been made in the method of overcoming shortening in exceptional cases by tenomyotomy. Its range of utility has been widespread since Dieffenbach first divided the triceps for fracture of the olecranon. Division of the tendo Achillis, the hamstring tendons, and of the sterno-cleido-mastoid may be done when it is evident that muscular contraction alone is responsible for the shortening or deformity. In this connection it is amusing by way of contrast to quote from Ricard on *Fractures.* In 1890 he wrote: "It is useless to add that to-day no one has recourse to tenotomy; not on account of the terrible mortality which Malgaigne had forty years ago—three deaths in five cases—but because tenotomy has become superfluous since anæsthesia and continuous extension are used in the overcoming of muscular contractions."

Cases are encountered in which anæsthesia, extension, and tenotomy combined will fail to reduce deformity, and in which we seem helpless to prevent an unsatisfactory result. Aside from fractures of the patella and of the femoral neck, wherein anatomical data for bony union are deficient, we are wont at times to see results far from good in fracture of the lower end of the tibia, of the femoral shaft, of the lower epiphysis of the femur, of the radius, of the elbow, and of the clavicle. The use of the cathode ray, where feasible, will doubtless tend to lessen the frequency and extent of post-fracture deformities by making easier the apposition of fragments. Yet there will be cases in which a clear picture of the lines of fracture will avail but little or nothing in the therapy. The interposition of muscle, ligament, or fascia, or of a loose fragment of bone in the line of fracture will, at times, prevent its reduction and from the very beginning forbode a result dreaded in proportion to the deformity entailed and its ensuing limitations of motion. In view of the successes now almost uniformly achieved in elective operations on the bones and joints, the question might well be discussed, whether, in otherwise irreducible simple features, early operative intervention should be refrained from. Such has been the surgical teaching of the past.

Even very recent writers are silent upon the subject, and the consultant would find little or no justification in converting a recent subcutaneous fracture into an open one to obtain a permanent better result. Nevertheless, individual points have been made in this direction: by Senn, in the direct fixation of fragments in injuries of the hip, by McBurney in fractures of the humerus complicated by dislocation, and very recently by J. W. Hearn (reported by Spencer), in the suturing of the broken clavicle. An unique position in the immediate operative therapy of fractures is occupied by the patella, fractures of which have often enough been united to render a verdict against immediate interference. Since it was my privilege, in 1891, to see Schede overcome a four-inch shortening of the femur from oblique fracture six months after the injury, I have believed that in certain cases an interference before union had resulted would be preferable to the certainty of deformity. The cases in which operation would be indicated are necessarily few. Nevertheless, seven cases have come under my observation in which the fracture was exposed and directly treated. I beg to submit brief histories of these cases:

CASE I. William F., aged twenty-four years, single, German; beer-wagon driver, admitted to the Good Samaritan Hospital May 1, 1892.

Diagnosis. Fracture of the lower end of the right tibia. In jumping to keep a brick wall from falling on him he landed full on his feet, but his right ankle turned, producing a fracture of the lower end of the tibia. The condition presented made the exact nature of the lesion difficult to determine. There was a very extensive hæmatoma about the ankle, very great widening of the joint, with crepitus easily felt. Under the extensor tendons below the line of the joint, surrounded by an hæmatoma, could be felt the loose fragment, which seemed to have the shape of the articular portion of the astragalus. Under anæsthesia every effort was made to bring this portion of bone into its normal relation between the tibia and fibula, but without success. A long anterior incision was, therefore, made over the joint and the loose piece of bone removed. It proved to be the outer portion of the tibia. It was pyramidal in shape, and the base was covered with cartilage. It measured an inch and a half in length and half an inch in thickness at its widest part, and evidently came from the articular end of the bone. Except for a small strip it was entirely detached. Through the incision the fracture of the lower end of the fibula was recognized. All clots having been removed, deep sutures were resorted to, the external wound partly filled with gauze, and retentive dressings applied. The first dressing remained in position ten days, and when it was removed showed the wound was dry. Second dressing applied on the twentieth day. When this was removed, on the thirtieth day, the joint was freely movable, and the splints were left off except at night.

June 14th. The splints were finally left off, and the patient was able to bear his weight upon the foot. Only slight impairment of ankle movement.

20th. Patient discharged well, walking without crutch or cane.

CASE II.—John H., aged six years. (Reported with permission of Dr. Krouse, in whose service the case occurred.) November 19, 1895, patient was thrown from a street car, sustaining a compound comminuted fracture of the right leg, and what at first seemed to be an insignificant injury of the lower portion of the left thigh. There was a good deal of contusion here, and quite an extensive hæmatoma. The condition of the right leg necessitated immediate amputation below the knee. During the recovery from the amputation, which did not unite by first intention, the hæmatoma in the lower portion of the left thigh disappeared and revealed an epiphyseal separation at the lower end of the femur. It was evident that the epiphysis was tilted upward and forward, and that the lower end of the shaft was protruding into the popliteal space, where part of its lower square surface could be clearly mapped out. The leg was retained in flexion with weight extension, in the hope of reducing the dislocation. The general condition of the patient did not justify an operative interference until December 30th, when an open incision was determined upon. An incision about three inches in length made in the mid-line of the popliteal space very readily exposed the transverse line of separation. The square surface of the shaft, without any adherent cartilage, was readily laid bare. The upper surface of the epiphysis, with its cartilaginous covering firmly adherent, had been tilted forward so that it was found to rest against the anterior surface of the upper fragment. Callus had not been thrown out. Extension failed to relieve the dislocation, even after the division of the nearest hamstring tendons. It was only after half an inch or more of the lower end of the femoral shaft had been chiselled away that the epiphysis could be tilted on its axis to a degree permitting approximation of the surfaces. After hæmostasis had been cared for, the wound was tightly closed except for silkworm-gut drainage. The leg was dressed in right-angle flexion.

During seven days after the operation it appeared as though primary union would result. This, however, was not accomplished, for the evidences of infection were seen on the ninth day, when the dressings were changed. Stitches had to be removed, since there was some suppuration.

The subsequent history of the case was that of ordinary infected compound fractures. The suppuration, which was at first extensive, gradually subsided, and that without necrosis. The patient was admitted to the Jewish Hospital on November 19, 1895, and remained in the institution until May 29, 1896, when he was finally discharged well.

This patient attends school regularly. In its growth the femur has kept pace with its fellow of the opposite side, although a sinus has formed, which I have been informed leads to a small sequestrum.

CASE III.—H. P., male, aged forty-three years, admitted to the Jewish Hospital June 5, 1892. Sustained a fracture of the right radius six weeks before admission. There are characteristic silver-fork deformities and radial abduction. The fingers are flexed, while extension of the fingers and wrist is limited. Pararticular firm œdema is very marked. During two days the arm and hand were retained in suspension to reduce the swelling. It was then evident that reduction had not been accomplished, although a large callus had been thrown out. The dorsal prominence of the lower fragment was very decided.

Operation, June 6th. An incision three inches in length was made along the outer border of the radius between the extension muscles of the thumb down to the bone. The periosteum was readily lifted from the callus. This was spongy and easily removed with saw and chisel, thereby clearly exposing the line of fracture. No evidence of impaction was found. Efforts at reduction failed until the bone was transversely divided with the chisel in the line of fracture. A reduction was then easily accomplished and the fragments retained in place. The wound was closed except for a small gauze drainage to care for the rather copious oozing. The arm was suspended during the first twenty-four hours after the operation.

The subsequent history was uneventful. After three weeks all dressings were dispensed with, and passive motion instituted. A supra-articular line of tenderness could be discovered, but there was no deformity. When the patient left the hospital, six weeks after operation, wrist movement was somewhat limited in dorsal flexion, and there was slight limitation of extension movements at the terminal digital phalanges. For all ordinary purposes the range and strength of motion of the fingers in flexion were normal.

CASE IV.—R. S., aged sixteen years, admitted to the Good Samaritan Hospital July 6, 1893. Four weeks ago from a fall patient sustained a fracture of the right radius. Efforts were made in the country, where the accident occurred, to reduce the dislocation, but evidently without success. Splints had been used almost continuously since the accident. The arm presented the typical deformity of a Colles's fracture, with impairment of motion in the thumb, index, and middle fingers, due to binding down of the tendons within the tendon sheaths. Point pressure over the site of the fracture was exceedingly painful. Under anæsthesia an effort was made to reduce the dislocation, but without success. An incision was, therefore, made along the outer border of the radius, three inches in length, and the fracture thoroughly exposed. There was no attempt at union. The line of fracture was readily discerned, and an impaction easily recognized. It was only after the bone was divided in this line with the chisel that reduction could be effected, and the deformity readily removed. The entire wound was closed without drainage, and the recovery was an uneventful one. Passive movements were commenced two weeks after the operation. The patient was discharged from the hospital six weeks after the operation with practically normal function of the wrist and finger movement.

CASE V.—R. F., aged nine years. Family history good; admitted to the Jewish Hospital December 26, 1895. On September 25th was run over by a bicycle and the right femur fractured a little below its middle. The fracture was very oblique, and shortening two and one-half inches. In the very beginning the case was treated by weight extension and lateral splints. Efforts at reduction made a week after the accident under anæsthesia failed to reduce the shortening. After six weeks the union was quite firm, with marked outward bowing. Shortening between two and one-half and three inches.

Operation, January 2, 1896. Incision five inches in length from the outer portion of the thigh over the site of fracture. Hæmatoma had entirely disappeared. The fracture was very oblique. The fragments which had passed each other were united by a bridge of new bone. With considerable difficulty this was severed with the chisel. The medullary cavity of the upper fragment was closed by callus, the lower was still open. The upper fragment was freshened by the saw. A Senn bone-ferule, largest size, was now introduced and the fragment brought into good position. Silkworm-gut drainage was resorted to, except for which the wound was tightly closed. A final recovery from the operation in this case was satisfactory in the extreme. Except during the first three days the temperature did not exceed 101°, after which it returned to the normal and continued so throughout the stay at the hospital. A fenestrated plaster-of-Paris dressing was applied immediately after the operation and retained in place six weeks. The patient left the hospital with the wound perfectly healed, on March 1, 1896. After he left the hospital some pressure necrosis from the ferule resulted. This was removed by Dr. E. W. Walker. The patient now, I understand, has a shortening of less than one inch, and walks with only a perceptible limp.

CASE VI.—G. M., aged thirty-three years, admitted to the Cincinnati Hopital May 12, 1896. Patient was in the hospital a year ago for delirium tremens. On the day of admission was run over by a stone wagon, sustaining fracture of the leg.

Physical examination reveals a fracture of both bones of the right leg midway between ankle and knee-joint. At the site of fracture there is a well-marked angle with outward opening. The foot itself is inverted, toes pointing toward arch of opposite foot. Very considerable hæmatoma at the site of fracture.

Under anæsthesia efforts at reduction were made. It is evident that a loose fragment intervened at the site of fracture, preventing reduction. Dr. Evans assisted.

Under A. C. E. anæsthesia, an incision three inches in length was made over the site of the fracture, from which a large quantity of blood exuded. When the fracture was thoroughly exposed a spiculum of bone one-third of an inch wide and over an inch in length was found wedged between the main fragments, which could not be brought into apposition until the intervening spiculum was removed. Reduction was then easily accomplished. The entire wound was tightly closed in the hope that primary union would result. This was evidently a mistake, for suppuration ensued within a week, necessitating the removal of the stitches. Some necrosis of the bone resulted, so that on July 18th a secondary operation with bone sutures had to be made.

The patient was finally discharged with a sound leg, walking without cane and with less than one inch shortening.

Case VII.—A. P., aged thirty-eight years, admitted to the Cincinnati Hospital December 22, 1896.

Present history. On date of admission patient received a gunshot wound of the forehead and of the left arm. When admitted she had recovered from shock. There was considerable hemorrhage from wound in the forehead, and she was unable to use the left arm. The wound of the forehead was a scalp wound and of no significance. On the outer side of the left arm about two inches below the acromion process was found the wound of entrance, probably made by a 38-calibre ball. Crepitus is felt if the arm is moved, and the head does not rotate with the shaft. An aseptic dressing was applied and external splints over extension. Both wounds in the scalp and in the arm healed by first intention.

January 16th. No evidence of union in the fractured humerus. A radiograph taken shows an oblique fracture about four inches below the shoulder-joint, with the lower fragment passing upward along the outer surface of the upper. The bullet is seen flattened against the inner side of the upper fragment, having evidently passed through the humerus.

18th. Under chloroform anæsthesia an incision three inches long was made along the outer surface of the arm, by which the fracture was exposed. Between the fractured surfaces an unorganized blood-clot adherent to shreds of periosteum was found and readily removed with curette. The bullet was removed. When extension was applied the fragments were easily brought into apposition and retained by a wire suture. The wound was entirely closed by deep and superficial sutures.

The subsequent history showed an infection, which was limited to the soft parts and was readily relieved by removing a few of the sutures. The patient was discharged on March 3d. The bones had united by a large mass of callus; arm function practically normal.

Remarks. Though the cases reported are few they are of sufficient diversity in regard to regional distribution and time of interference to warrant some general conclusions.

In two of the cases interference was immediate, and in two osseous union had occurred. In one of the cases of immediate operation suppuration resulted, whereas in the other complete primary union took place. In only two of the cases in which operative interference was delayed did suppuration result. The inference may possibly be drawn herefrom that early interference predisposes to infection. This can readily be explained by the lowered vitality of the contused tissues and their notably reduced resistance to infective processes. This inference is strengthened by reports from many surgeons who have resorted to direct mechanical appliances for fixation of fragments in compound fractures or for the cure of pseudarthroses. I would only refer to the cases in which Senn used the bone ferule and Bircher the ivory plug. Nevertheless, since in all of these cases, by the interference plus the infection, the end result was better than it would probably have been without operation, the patients were brought only into the condition of one who had primarily sustained a compound fracture.

The lesson is plain, however, that extraordinary precautions toward securing asepsis must be taken before the simple is deliberately converted into a compound fracture.

Of fractures through the epiphysis two cases are recorded, one of the lower end of the radius, the other of the femur. Both of these cases were operated upon before callus had been thrown out.

In two cases operation was delayed until quite firm union had been effected. The operations were, therefore, for vicious union. Although nature does much to cover the inequalities left from the fracture, in neither of these cases would a good result have been obtained without operation. The question is, therefore, pertinent, if when deformity is certain to follow fracture it is not better to wait until union has taken place. Aside from the doubtless greater danger from infection in immediate operations, no strong argument can be advanced in favor of delay. Particularly is this true in epiphyseal separations. In those of the lower end of the femur the danger to limb and even to life from compression of the vessels is very great. An early interference can only be of advantage whereby the production of deforming callus will be forestalled. The technical difficulties of operation before callus has formed are very much less than those which attend the operative corrections of vicious union after fracture. Such fixation of epiphyseal separation need not necessarily imply an open wound, since by means of long pins driven through the skin, Helferich has recently succeeded in fixing the humeral epiphysis. The same procedure was employed several years before by Lange, and the principle is that advocated by Senn in fractures about the hip. It is very possible that by means of such a drill and with skiagraphic tracing of the fracture, say of the elbow or of the ankle, before him, an operator can transfix fragments without open incision and retain them in position by means of the drill.

There are certain classes of cases in which open treatment should be strictly ruled out, even if the deformity is great. In cases of crushed fracture, where extensive comminution can be made out, nothing could be gained from operative interference. Altogether, therefore, the cases in which the open treatment should be resorted to would be few and far between. Nor does the experience of the writer, or what he has gleaned from literature, warrant him in coming to conclusions that are final. Nevertheless, he believes that it would be justifiable to submit in a tentative way the following postulates:

1. The conversion of a simple fracture is justifiable when other means to secure the best end results fail.
2. In fractures of the diaphysis of the tibia, femur, humerus, and clavicle in which insurmountable longitudinal displacement or axial rotation has taken place, immediate operation or mediate operation before definite union has occurred is indicated.
3. In epiphyseal separations, when reduction cannot be otherwise effected, an early operation is justified.
4. Fractures complicated with dislocations irreducible by other methods warrant operative interference.
5. The involvement of a joint, except probably in the case of knee and hip, do not, *per se*, militate against operation if this is otherwise indicated.
6. If extensive comminution is present, as in compression or crushed fracture, operation is contraindicated.
7. Special precautions against infection must be taken, in connection with which should be borne in mind the dangers of too firmly closing a wound and the advantage of temporary tamponade and secondary suture.
8. Reckless and indiscriminate resort to the operative relief of deformity in recent simple fractures is to be condemned, since there would be few fields of surgery, in the event of an unsuccessful intervention, in which the contrast could be greater between the good intended and the harm done.

ON THE VALUE OF ATHLETIC EXERCISE AS A COUNTER-AGENT TO THE SEDENTARY PURSUITS OF URBAN POPULATIONS.[1]

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WE often hear that a healthy mind can only be found in a healthy body. This is a great fact. We too often meet with instances which illustrate the converse of this, and have no lack of opportunity of wit-

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[1] An address delivered before the Birmingham Athletic Institute.